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## SIXTH ANNUAL REPORT OF THE SECRETARY OF THE BOARD OF EDUCATION.

[Continued from page 288.]

Another wide departure from nature's "Health Regulations," in regard to diet, consists in eating at unseasonable times. Different nations, ancient and modern, as well as different classes in the same nation, vary greatly from each other in respect both to the hours of meals and the frequency of their succession; and much has been said of the relative propriety of their customs. But a universal rule, as it regards the individual, is, never to eat, either while the previous meal is still undergoing the process of digestion, or immediately after that process is completed. After food is received into the stomach, it is warmed, if too cold; it is cooled, if too warm, until it acquires the temperature of about 100°. If too dry, the stomach demands moisture; if too watery, the water is drained off until it is prepared to be mingled with the gastric juice. In a healthy adult the process of digesting a hearty meal occupies from three to five or six hours, according to the more or less digestible quality of the food. Now, when the follicles of the stomach have given out what gastric juice they contain, when the work of digestion has so far advanced that the qualities of the food are chemically changed from what they were when received, what can be more unnatural or absurd than to introduce a new mass of raw material, which requires a new exuding of, and saturation by, the gastric juice, already exhausted; and which must be mingled, by the action of the stomach, with the food of the preceding meal, now half-prepared or nearly prepared to leave the organ? If, in any culinary preparation, an equal quantity of new raw material were introduced, just as the process of cooking the original should be completed, it would hardly make the compound more unsavory to the palate than this practice makes the chyme unhealthful to the body. Yet how often is this done, either through ignorance, or to gratify appetite, or to subserve some temporary convenience about meals, or,—what is worse than all,—for the monstrous purpose of eating a meal or two *in advance*. To wrap ourselves in furs and flannels, during the heats of summer, as a preparation for

winter's cold, would not be a greater outrage against nature, than to eat in advance of hunger. A rule never violated without incurring serious penalties, either immediate or remote, is, not to eat a second time until the previous contents of the stomach have been digested and are passed away, and that organ has had a season of repose. Alternate action and rest is the universal law of every power and faculty, both of body and mind. So too, after taking even a moderate meal, all severe exertion, whether mental or physical, should, for a brief season, be remitted. Especially is this important in regard to students and others who lead sedentary lives.

Following the course of nature, I should be next led to trace the steps by which the digested food is carried to the blood, to be distributed through the circulation for the growth and nourishment of every part of the body. But my present object being only to show the practical and every-day value of physiological knowledge, I pass by, with a single remark, those wonderful processes which nature performs in the secret laboratory of the system. Whoever feels delight in tracing effects to causes, or loves to contemplate the wisdom and beneficence of the Creator, will find, in this department of his works, an inexhaustible source of intellectual gratification; and, at every step of his progress, exclamations of thankfulness and adoration will burst spontaneously from his lips. But it must suffice to observe, that after the aliment, in a fit state for nutrition, has been passed from the stomach, and has received the appropriate secretions from the liver and pancreas, it is then taken up, or drawn out from the great alimentary canal, through tubes or ducts which are microscopically fine, and inconceivably numerous. These tubes or ducts, (technically called lacteals, from the Latin word *lac*, signifying milk, because the substance which they take up very nearly resembles milk in its color and consistence,) after traversing winding passages, and passing through various ganglia, are at length all gathered into one tube or channel, called the thoracic duct, which ascends behind the heart in a direction towards the left shoulder, and empties its precious contents into the left subclavian vein, just before that vein, uniting with the vein which ascends from the lower extremities, pours the returning blood of the whole system into the heart.

Over our nourishment, after it passes from the stomach, until its stream is mingled with the blood, and reaches the heart, we have no control, except through medicinal agents. On leaving the stomach, it descends, as it were, into subterranean channels, beyond our reach or direction; and, in the invisible recesses of the body, it passes through organs whose uses are not known, and is subjected to chemical changes, which the art of the physiologist has not yet detected; but on reaching the heart that vital stream may be said to reäppear upon the surface, because in that organ it is directly subject to mechanical action from without.

The human heart is sometimes said to be a double organ; but by this it is only meant, that its right and left sides perform

different operations;—the right side of the heart propelling the blood into the lungs, and the left side propelling it over the rest of the body. These sides of the heart, though similar in their general structure and uses, and constituting the same general organ, are yet, *as to the course of the blood*, distant from each other the entire length of their respective circulations;—that is, the blood in the right side of the heart cannot reach its left side, (although separated only by a thin partition,) without going through the lungs; and the blood in the left side cannot reach the right side, without going round the whole system except through the lungs.

But when the blood, now enriched with nourishment from the food, enters the lungs, it is emphatically ours. Here, in a large sense, our strength, our health, our life, are placed in our own keeping. Here is an organ by whose proper use a vast portion of all the diseases which afflict humanity may be prevented. Here is a point, too, where many diseases may be met and cured. Here we are invested with almost unlimited power over health and life, and attached to this power is a corresponding responsibility.

That our blood is our *life*, is not only the declaration of Scripture, but the common conviction of mankind. But no part of our animal organism, no part of animated nature with which we are acquainted, is so short-lived as the blood. The insects which live but for a season, the tribes of ephemera which die on the day of their birth, are common emblems of the brevity of life; but the shortest of their terms of existence is longevity, compared with the vital principle of the blood. Water, milk, the expressed juices of vegetables, unfermented liquors, will ordinarily remain for hours unchanged; but the blood will perish irrecoverably in a few minutes, if not renovated by a foreign power. It is probably the most perishable of all organized living substances. Yet this blood has inexhaustible resources of life in pure air. On this element it constantly relies. Without air, the life of the blood expires, like the flame of a candle beneath an extinguisher; but give it air, and its vital power will subsist for days, and sometimes for weeks even, though no food or drink is taken into the system. Let the lacteals pour into the blood the results of their most perfect elaboration, and, without air, it dies forthwith, and the process of corruption or putrefaction commences. Food is an occasional want, air a perpetual one. So indispensable, so continual, so instant at all times, is the necessity of pure air to vitalize* the blood and sustain the life of man.

In the course of its circulation, the blood comes to the lungs in search of life, that is, of pure air. From the trunk, from the

* The terms "vital," "vitalize," "vitalization," and so forth, are in universal use, among physiologists, to express the effect which pure air produces upon the blood. In a strictly *chemical* sense, this use of the terms may not be literally correct, for the venous blood is not decomposed or destroyed, as blood, by being carbonized; but in a *popular* and *practical* sense, these terms and their equivalents are not only true, but they express a fact,—viz., the power of the oxygenated blood to support the life of all the other parts of the system,—which it would be difficult to render so intelligible to the common reader by any other form of expression.

brain, from all the extremities, it is hastened onward to the lungs, just as a diver ascends to the surface of the water in quest of breath. As the blood is driven into the lungs by the strong propulsion of the heart, so the air is forced downwards into the same organs, by a pressure equal to a weight of fourteen pounds on the surface of each square inch. The lungs are the common ground where these two great life-sustaining agents meet; and here they are sure to meet, unless forcibly kept from each other, by the most egregious folly or wickedness of man. If air is admitted into the lungs to greet the blood on its arrival there, and to impart its vital properties to that fluid, then the blood flows back rejoicingly to every part of the body, carrying health, spirits, strength, activity, endurance, and bountifully dispensing a gladsome sense of existence wherever it goes. But if, on the other hand, the air is debarred from admission into the lungs, or if only impure air is admitted, then the blood flows back in its course, languid, infectious, inflicting torpor upon every sense, and disease upon every organ. Hence it is not too much to say, that the relation of the blood and the air to each other, and the mechanism of the lungs, where these wonder-working agencies meet to reciprocate benefits, constitutes one of the most valuable as well as most interesting departments of worldly knowledge.

The air, as it is seen, and felt, and breathed, appears to be a simple, uncompounded body. But, in reality, it is composed of three ingredients, as different from each other as light from darkness, or fire from ice; and a chemist will separate these three elements from each other as readily as an expert seamstress will untwist a cord composed of three different colored threads. These three ingredients are oxygen, nitrogen or azote, and carbonic acid gas. The oxygen constitutes *twenty-one* parts in a hundred of the whole bulk. Dr. Combe says, that about *seventy-eight* parts in a hundred are nitrogen; and the residue only, or one per cent., is carbonic acid gas. Some physiologists differ a little from this authority in regard to the proportion of carbonic acid in the air.* But this is not material. Dr. Combe further says, that, at every breath, "*eight* or *eight and a half* per cent. of the oxygen or vital air have disappeared, and been replaced by an equal amount of carbonic acid." This being the case, it follows that breathing the *same* air only three or four times, successively, would exhaust it of all its oxygen, and leave the carbonic acid in its place.

The oxygen of the air is the supporter of human life. Everything else may be as it should be,—perfectness of organization, soundness in every part, nourishment, temperature,—but take

*Johnston says, "On an average this carbonic acid amounts to about $\frac{1}{2500}$th part of the bulk of the air."—*Johnston's Agricultural Chemistry*, pp. 35–6.

Liebig says, "The most exact and most recent experiments of De Laussene, made in every season for a space of three years, have shown, that the air contains, on an average, 0,000,415, of its own volume of carbonic acid gas; so that, allowing for the inaccuracies of the experiments, which must diminish the quantity obtained, the proportion of carbonic acid in the atmosphere may be regarded as nearly equal to $\frac{1}{1000}$th part of its weight."—*Liebig's Agricultural Chemistry, (Prof. Webster's edition,)* p. 42.

away oxygen, and almost instantaneously the strongest man is a corpse. This ingredient, which is the supporter of life, is identically the same with that which supports combustion. Wherever the flame of a candle will of itself go out, a man will die. Keeping this universal truth in view,—that it is the same principle which supports human life, and which supports combustion, and every individual will have a thousand illustrations at hand, to show the relation in which he stands to this vital element of the air. Few persons are unacquainted with the experiment of letting down a candle into a stagnant well, vault, or pit of any kind; and it is understood that if, in such places, a candle will not burn, a man will not live. Carbonic acid being much heavier than an equal bulk of oxygen or nitrogen, it settles in the lowest places.* It therefore fills up any depressions or excavations which remain for a long time unoccupied or unopened. It becomes the sediment of the atmosphere, as mud is the sediment of water. When a stream flows rapidly, the earthy particles or impurities which it may contain, are mingled with the whole mass of the water; but if the stream expands into a quiet lake, the earthy materials subside to the bottom. So in regard to the air;—whenever it is in motion the carbonic acid is held in mechanical solution with its whole body, but this ingredient will rest at the bottom of unoccupied vaults, wells, &c., until it is expelled from them by some mechanical force, or neutralized by some chemical agency. If ever there were any one who had so little philosophy in his composition as to apply an extinguisher to a candle, without thinking why he succeeds in putting out its flame, he has only to learn that it is because the extinguisher cuts off the stream of air that sustains the blaze. Our lungs are in precisely the same condition; if isolated from the air, we perish by suffocation; but, organically speaking, it is not, as most people suppose, because life departs, but because *it ceases to come.* If Othello "put out the light" of the candle by an extinguisher, before smothering Desdemona in her bed, he only repeated in the second operation, so far as the natural laws are concerned, what he had done in the first. We kindle our fires by repeated blasts from the mouth, or from a hand-bellows; we apply a sheet-iron blower to a grate; all our stoves and furnaces are so constructed that we can graduate the current of admitted air; and we should at once discard the workman, as a bungler, who should fail in any of the contrivances for that purpose. The smith and the forger increase the intensity of heat for their respective operations, by the use of a stationary bellows, worked by the arm or by steam; the engineers of the steam-ship and locomotive admit a quantity of air into the fire-chamber, exactly proportioned to the amount of work to be done;—and in all these cases we say, colloquially, that we increase the draught

* In this cursory view of the subject, I take no notice of the facts that one gas is a vacuum in relation to another, and that the particles of the same gas have a repellent power in regard to each other, which tends to their diffusion, until that tendency is overcome by gravitation. Whoever would acquaint himself with these beautiful chemical laws must examine the works of the chemists.

of air; but it is an increase of the quantity of oxygen only, which produces these results. Let the draught which is applied consist of nitrogen, or of carbonic acid, and the fire, instead of being roused, will be extinguished in an instant. Even gunpowder will not burn without oxygen. It is not the seventy-nine hundredths, therefore, of nitrogen and of carbonic acid, but the twenty-one hundredths of oxygen, to which we are alike indebted for the mechanical power of steam, for the brilliant flame of lamps, the genial heat of fires, and for our own physical existence, from minute to minute. And yet, with all these proofs and examples continually before our eyes, we fly, as a people, from the invigorating influence and exhilarations of the open sky; there is a more and more eager quest for in-door and enervating employments; we strive to circumvent nature by occupying winter apartments, whose doors and windows are almost hermetically sealed; we sleep in low, narrow and close rooms; we send our children to inhale disease in unventilated schoolhouses; we attend the lecture-room or other large assembly, where there are no provisions for a change of air; and many mechanics and operatives, although they know, from constant experience, that their own machinery will cease to move if fresh air is not supplied to the engine, still breathe an atmosphere themselves which would hardly keep their own fires alive. Amid an almost universal want of knowledge respecting the physical laws, each man's ignorance is kept in countenance by that of his fellows.

It was remarked above, that, keeping the fact in view that the oxygen of the air is alike the supporter of life and of combustion, every man could find numberless illustrations, in his daily experience, of his constant dependence upon this element for the continuance of life. The application of this truth is still more direct and significant, when we consider that it is no other than this very process of combustion itself, by which the degree of warmth necessary to our existence is kept up in our bodies. In healthy lungs and blood-vessels, no less than in the fire-places and furnaces of our dwellings, or in smitheries, forges and locomotives, is there a constant combustion going on, while life lasts. Strange as it may seem, yet it is still true, that every living man is on fire, though in some, as we might naturally infer from their torpidity and sluggishness, there are only a few smouldering and decaying embers, enveloped in their own soot and cinders, and on the verge of extinction. The standing temperature of our bodies, at all seasons of the year, is 98°. If our temperature falls below that, and so continues, the machinery will no longer play, and life ceases. The mean temperature of our atmosphere, for the whole year, is about 47°. Sometimes, however, it falls to a dozen or more degrees below zero, making, in such cases, a difference of one hundred and ten or more degrees, between our own temperature and that of the air by which we are surrounded. Our persons are just like any other substance, enveloped in a medium colder than itself. It is a universal law that there is a constant tendency to equilibrium among bodies of different temperatures,

and of course a cc tant loss of heat on the part of the warmer body. Whenever, therefore, the temperature of the atmosphere is below 98°, (and, in our climate, it is always so, except during a very few hours of a very few days in the year,) heat is constantly radiating from our bodies into the surrounding air. With the thermometer below zero, and with lungs and blood as much exposed to the open air as in a living subject, a man of ordinary size, if instantly struck dead, would probably lose every particle of his warmth in half an hour. And yet, with sufficient food, and a proper quantity of exercise, many men,—travellers, shipwrecked sailors, and others,—have been known to sustain the system at the life-point of 98° for hours and even days together, without any aid from artificial fires. This striking result is effected by the generation of heat,—that is literally by fires,—within themselves. Material capable of being burned,—in this connection, it would be strictly correct to call it *fuel*,—is derived from our food, and from the tissues of the body previously formed from the food. This fuel is carried into the blood. In the lungs, the oxygen of the air is also absorbed into the blood; and here, therefore, the combustible material and the supporter of combustion meet. Fire is kindled, by means of which the temperature of our bodies is raised to 98°. And not only so, but a quantity of surplus heat is generated sufficient to repair the immense loss occasioned by our being immersed in an atmosphere so much colder than ourselves, and which is constantly stealing from us so much of our warmth.

This combustible material is called *carbon*. Chemically, it is the same material with the combustible part of our wood, coal, peat, or other fuel. The blood of every person in health is richly freighted with it. A part of this carbon is obtained directly from our food; a portion of it is obtained from the waste or used-up particles of the body. In a healthy subject, every organ is undergoing a rapid process of waste and renovation. All muscular efforts, all nervous activity, cause a loss of the very substance of the muscles and nerves themselves; but new particles, fresh, young and vigorous, take the place of the old ones. The old, however, though detached and cast off from the living tissues, are not wholly worthless. Many of them are thrown into the current of the blood; and, as they consist, to a considerable extent, of carbon, they are burned. This is the same economy which a man practises, when he repairs or pulls down his old house; he uses the waste materials of the old dwelling to keep up a fire to warm himself in the new one.

If any one doubts that an active fire is sustained in the interior of the body, let him explain how it is that the lungs of a person in health *are never cold*. Such a person may remain for hours in an atmosphere below zero;—he breathes eighteen or twenty times in a minute, and, therefore, eighteen or twenty times a minute, he admits a blast of this ice-like atmosphere into the whole substance of the lungs. Frost may fringe his eyes; icicles depend from his mouth; his ears, cheeks, and nose

may be frozen, and yet his lungs will experience no sensation of coldness. Suppose the interior of our hands, our arms, or our feet were, like the lungs, permeated by tubes, or hollowed out like honey-comb, and that an atmosphere below the point of congelation were constantly rushing into these tubes or cells, abstracting their heat and imparting its own cold,—how long before they would be frost-bitten? Nothing but the genial warmth generated in the lungs, by the carbon of the body and the oxygen of the air, saves them, during any cold winter's day, from such a fatal catastrophe.

In bulk, the principal ingredient of the air is nitrogen. It constitutes nearly eight tenths of the whole mass of the air. This ingredient, so far as the lungs are concerned, seems to have no active properties. It is a mere diluent. If oxygen composed the whole body of the air, almost everything, except ice and granite, would be consumed in it. A common candle would be burnt out in a few minutes. Should fire ever escape from our control, it would end in a universal conflagration. By the stimulus of pure undiluted oxygen, received into the lungs, all vital movements would be so accelerated, that life would be consummated in a few days. But nitrogen reduces the stimulus of the air to that precise degree, which conduces at once to the greatest activity and the longest duration of existence.

Carbonic acid constitutes but a very little of the whole bulk of the air,—being estimated by some chemists at one per cent., though by others at much less.* Its properties are strikingly distinct from those of either of the ingredients with which it is combined. Oxygen, as has been said, is the supporter of life; nitrogen is neutral; but carbonic acid is a deadly poison. Constituting, however, so small a portion as it does, and being equally diffused through the whole mass of what we call pure air, it works no mischief. It is only when breathed by itself, or when it is a large proportional of what we breathe, that its destructive properties are manifested. When breathed alone, death immediately ensues.

Whenever combustion takes place, this carbonic acid,—this deadly poison, is generated rapidly and in great quantities. When oxygen and carbon combine in the body, they evolve heat, *and carbonic acid also.* It is the same operation precisely which is carried on when a brasier or pan of charcoal is burned in our rooms. The oxygen of the air in the room combines with the carbon in the coal, and gives out heat and carbonic acid. So, in the body, the oxygen of the air received into the blood through the lungs, combines with the carbon already in the blood, and gives out both the heat and the gas. If, then, there were not some mode of expelling this gas as fast as it is formed, we should soon be killed by a poison of our own creating. It has been said that the blood goes to the lungs in quest of oxygen. That, however, is not its only errand. It goes there, also, to discharge the carbonic acid which has been gen-

* See note on page 292.

erated by the combustion that has taken place during the circulation of the blood around the body. The lungs, therefore, are a contrivance not only to introduce oxygen into the blood, but to take carbonic acid out of it. We know that if we burn coal in a close room, and breathe the gas which it exhales, it will produce suffocation and death. So if the lungs were closed,—that is, if we should cease to throw off the carbonic acid produced by the burning of carbon in the blood, it would equally cause suffocation and death. Hence a chimney for its egress, and a current of inflowing air, are necessary to carry off this deadly ingredient from our rooms; and many persons are aware of this fact, who seem to be either ignorant or heedless that a similar current of pure air is equally necessary to remove this fatal poison from their lungs.

From the above it will be perceived that every breathing thing is a laboratory where the work of destroying the vital property of the air, and of producing poison in its stead, is constantly going on. And although the quantity of the air is exceedingly great,—being said to cover the whole globe to the height of fifty miles, and doubtless existing, though in an extremely rarefied state, to the height of a hundred miles or more; yet, in process of time, with all the myriads of lungs which belong to all the orders of animated nature, unceasingly at work, why should not its whole mass be gradually changed from wholesomeness to poison, from life to death? At any rate, as carbonic acid is much heavier than oxygen or nitrogen, why should it not accumulate upon the surface of the earth, filling all its valleys, overflowing its plains, and rising, like a deluge, along its hill-sides, until, at length, the last island peak of the highest mountain should be submerged, and universal silence and death reign over animated nature,—self-destroyed, by converting into poison the very element which had been given for its existence?

But in this case, as in all others, where a presumptuous philosophy has conjectured that Divine Providence was at fault in any of its arrangements, that philosophy has only to push its researches further, to turn the very difficulties which it encountered, into new evidences of adorable wisdom. In the economy of nature, ample provision is made for the reconversion of the carbonic acid into carbon and oxygen. This process may take place spontaneously, in order to restore the equilibrium between them; and during the operation, as much heat may be absorbed and pass into a latent state, as had been given out in the formation of the acid. The most obvious and beautiful provision, however, consists in the relation which the animal and vegetable worlds hold to each other. Animal and vegetable nature constitute a whole. Each is the supplement of the other. Oxygen is the life of the animal kingdom; carbonic acid is the nutriment of the vegetable. All breathing existences consume the oxygen and produce the acid, while vegetable existences consume the acid and produce the oxygen. The countless myriads of lungs, in their ceaseless heavings, are constantly absorbing the latter from the air, and ejecting a stream of the

former, compared with which the volume of the Mississippi or the Amazon would be but a rill. But, on the other hand, the tenfold myriads of the blades of grass and the leaves which make verdant the forest and the field, absorb our poison as their nourishment; and, in its stead, they elaborate and pour forth a flood of oxygen for the sustentation of the animated world. Thus decomposition and recomposition are equal. The ebb and flow of the mighty tide of conscious and unconscious life, are mutually sustained. As water is evaporated from the surface of the ocean and the land, into the sky, to be thence precipitated in fertilizing showers; and, after gladdening the earth and replenishing the sea, is again carried upwards on its perpetual circuit of beneficence; so the animal and vegetable worlds prepare, each for the other, these elements of their respective existences, and pass them backward and forward, as from hand to hand, in continual exchange;—the ever-restless winds being the unchartered medium of the beneficent commerce.

For maintaining the wonderful relationship which exists between the corruptible blood within us, and the life-imparting air without, the lungs are the appropriate and principal organ. Doubtless, the air is brought into contact with the blood through the skin, especially when that important and *vital* organ is kept clean; but this can be effected only to a very limited extent. The common mart, where the air goes to exchange its oxygen for carbonic acid, and where the blood goes to exchange its carbonic acid for oxygen, is the lungs.

To an ignorant observer, the lungs are a large, unshapely, unattractive mass, of a reddish hue, having neither beauty of form, structure or coloring. But the philosophic observer cannot look upon them for a moment, and consider their curious internal construction and their important functions, without an overflow of that intellectual delight which springs from seeing an adaptation of the simplest means to accomplish ends of extraordinary niceness and difficulty.

The lungs are very large, occupying the whole internal cavity of the chest, (with the exception of the space occupied by the heart, which is ordinarily only about the size of the owner's clenched hand,) and therefore filling almost all the space between the breast-bone and the shoulder-blades, and between the bottom of the neck and the diaphragm, or middle line of the trunk. It is, therefore, obvious that, in a full-sized man, they are of sufficient capacity to hold many quarts of air and blood. Their internal structure is spongy and porous in the highest degree. This sponginess of structure results from the fact, that throughout their whole substance they are pervaded by three sets of vessels,—the first two being for the blood, the third for the air. The blood is driven from the right side of the heart into the lungs through one channel only,—the pulmonary artery,—but as soon as this artery reaches the lungs, it branches out into a countless number of tubes, which spread and divide until they penetrate every part of the whole mass of the organ. Should we imagine a tree with its trunk branching out into limbs, and

its limbs branching out into twigs, until the latter became so thick as almost to exclude the light by their crossings and interlacings, such a tree would be a good representation of the manner in which the pulmonary artery branches out into blood-vessels on reaching the lungs. But when the blood reaches the extremities of its thread-like vessels, it does not stop and return back to the heart by the same passages which conveyed it out. It flows onward and *through* the lungs,—the second set of vessels being only a continuation of the first. The tubes which carried the blood outwards, after reaching their extreme point, bend and turn backwards towards the heart; and, as in going out they had become more and more numerous, by division, so, on their return, they become fewer and fewer, by union with each other, until at last they are all gathered into one channel, —the pulmonary vein,—and returned to the left side of the heart. As in the one case they were divided from a trunk into branches, and from branches into twigs; so, in the other, they are united from twigs into branches, and from branches into a trunk. It is like one great thoroughfare leading into a city, which, on reaching its confines, begins to divide and diverge into numberless streets, lanes and alleys; and these, after traversing every part of the place, converge towards a common outlet, which leads from the city on the opposite side, by another great thoroughfare. Such are the two sets of blood-vessels,—arterial and venous,—which occupy the body of the lungs; and from whose number and closeness to each other, one might suppose that no room would be left for anything else. But the spaces for the reception of the air are almost as numerous as those for the reception of the blood.

The air finds access to the lungs through the mouth and nostrils. It descends through the windpipe, which, at the bottom of the neck, divides into two branches, one going to the right, the other to the left lung. As soon as these two air passages reach the body of the lungs, they branch out in the same manner that the blood-vessels do; so that, throughout the whole substance of these organs, an air cell lies side by side with a blood-vessel. The sides or walls which separate the air cells from the blood-vessels are exceedingly thin, filmy and gauze-like. They are so strong as to keep the air and the blood each in its own passages, and yet of so fine a texture as to allow the carbonic acid of the blood to escape into the air cells, and the oxygen of the air to be absorbed into the blood-vessels. They allow each one to come to the other, which is life;—they prevent each one from extravasating into the other, which is death. The air which we inhale at a single breath, if received into the circulation, would destroy life in a minute. The blood which at any one time occupies the lungs, could it burst its bounds and escape, would also destroy life instantaneously. Yet in this receptacle of the lungs do these two necessary, yet opposite elements, meet, while life lasts, to reciprocate benefits,—each approaching the very limits of danger, but never transgressing them, without some fault or improvidence on our part.

[To be continued.]

## CORPORAL PUNISHMENT.

[We had hoped to obtain, before this time, a full report of the discussion, which took place before the American Institute, on this subject, but have not been able. We are glad to publish the following report of what was said by Mr. Page. We substantially agree in the opinion he maintains.—Ed. p. t.]

Mr. Page, of Newburyport, said,—though the evening was far spent, he could not refrain from expressing his strong dissent from the sentiments just uttered upon this subject. Perhaps too much had been said within a few years past against corporal punishment, and sometimes he had heard very hard things said in a very *flippant* way; giving evidence that the speakers had no very deep knowledge of human nature, or of the wants and condition of our public schools. On this occasion, he was happy to say, the opponents of corporal punishment had manifested a different spirit,—a philanthropic,—a Christian *spirit*,—a *spirit* with which he could heartily sympathize; but nevertheless he could not believe that the zeal manifested thus far, on their side of the question, was strictly "according to knowledge." The system recommended by the gentleman from New York, (Dr. Mason,) might do very well for the school under his rectorship, (the University Grammar School, N. Y. city,) where admission was considered a privilege, and expulsion deemed an evil, and where there were numbers standing ready to fill the ranks as soon as a vacancy from any cause should occur. It might do for the school of which his venerable friend from Nantucket (Cyrus Pierce, Esq., late of the Normal school at Lexington) had had the charge. But it must not be forgotten, we were discussing a *general principle*, a question of very wide application, one which would affect the schools of the country as well as those of the more populous towns of the sea-board,—one which extends to the scattered villages and hamlets among the hills of Berkshire, as well as to the crowded cities of this and the sister States.

The *question* then, he conceived, resolved itself into this:—"Under the present condition of our public schools, both in town and country; under the present state of parental discipline; the present standard of qualification and amount of moral power of our public teachers; under the present condition of the *laws* of this or any of the States, upon schools,—taking men and things as we find them, and not as we would have them,—can we dispense altogether with corporal punishment as a means of school government? *Is it safe* to denounce it altogether as an unjustifiable and inexpedient resort?"

To the question, in a form like this, he felt constrained, notwithstanding the ability and zeal manifested on the other side, to give a *most emphatic answer in the negative.*

It was not his design, he said, to advocate the general, nor even the frequent use of the rod. He doubted not its use had been altogether too frequent a resort in many of our schools,

and that in many instances the inflictions were accompanied by bad temper, both on the part of the punished and the punisher. He *sincerely believed* that the good teacher, of a well balanced mind and a persevering spirit, after having once established good order in the school, could do very well without the frequent use, and perhaps, in some favorable cases, without any use of the rod. But he *as* sincerely believed that the greater number of teachers now actually employed in the greater number of the schools now in operation, could not sustain their authority without some use of corporal punishment, or the *fear* of corporal punishment. He was born in the country, had attended school in the country,—had taught school both in the country and in town,—had had some opportunity for observation both as to schools and teachers, and, from his experience as well as observation, he was satisfied, in his own mind, that the belief just expressed was founded in the truth. It was incumbent upon him, perhaps, to make this appear to the audience present.

1. He was inclined to believe that *the present condition of the public schools makes the rod necessary.* Many of the schools are very large, and composed of scholars of all ages and of both sexes. Many of these schools are subject to a change of teachers once, and some of them twice a year. In many of the districts the appointments are made by a small majority in favor of a candidate, to the bitter displeasure and disappointment of a large minority, who desire another. The disapprobation of the appointment being not unfrequently expressed, in presence of those who are to be scholars, by their parents, the scholars are incited to rebellion and disorganization, even before they meet their teacher in the schoolroom. These feelings are carried there, and the teacher meets insult and disobedience as he crosses for the first time the threshold of the schoolhouse. His term is a short one, his school is large, and he feels that if he is to be successful in the instruction of the school, his order must be established *forthwith.* Time cannot be spared for the exercise of the slower process of moral suasion, if he had the moral power. Perhaps he lacks even that. Shall he submit to insult and disorganization, and attempt to "live along" as best he may? The experience of fifty in a hundred proves that such a submission would result in an ejection from the premises within a very short time. Shall he give up in despair, and leave the school to some new aspirant to his office? This would be giving the refractory a triumph, which would strengthen them four-fold for any subsequent conflict. Besides, who knows that a successor can be found, at this late day, and amid such discouragements, to take his place with better promise of success? Knowing, then, that he must gain authority *by force*, if he gain it at all, and knowing too the numerous evils that may result from choosing either of the other courses,—considering the evils to the school if he fails, and the ruin to his own prospect as a teacher, what advice shall we give him?

However much we may love moral suasion, and however much we may deplore the necessity of a resort to the severer mode,—a necessity existing in the district, in the school, in

the man himself,—shall we say, *it is wrong to use the rod?* Shall we proclaim to him, in his trials, that if he cannot govern by moral power he must give up his place? To questions like these, it seemed to the speaker, there could be but one answer from those who have fully considered the subject. That answer is, *establish your authority, and do it at once.* Even the gentleman from New York (Dr. Mason) admits that the *necessities* found in Solomon's time might have justified the exhortations to severity which he gave. This is a concession that punishment is *sometimes* expedient; and scarcely any circumstances can be imagined, which would more clearly justify it, than a school in rebellion, ready to scoff at the overtures of kindness and treat with the utmost contempt any measure not prompted by the most decided energy.

2. *The present condition of parental discipline makes the use of the rod necessary.* The world has not yet advanced so far in moral excellence, that parents universally pursue the most judicious course in the early management of their children. From early childhood many of the young are taught to respect no authority but that which the rod enforces,—and they resist the first advances of a more desirable influence. Such children, when grown larger, often despise the milder attempts to bring them into orderly subjection, and seldom yield cheerfully to influences of persuasion till they have been taught, in a practical way, to *respect* the decision and energy of the man who is nevertheless willing to persuade. Until parental discipline shall be more uniform, more judicious, and we may add *more successful*, we may not yet denounce the rod as an occasional assistant in our schools.

3. *The existing laws relating to schools are such that the rod cannot be dispensed with.* By our laws *any person* may belong to the schools, whatever may be his moral character or his influence. The power of expulsion, if it exist at all upon the statute book, is so dimly defined, that it is seldom exercised in the country schools; and even in our larger undistricted towns, where the power is sometimes assumed, it is somewhat doubtful whether the law would authorize the measure. The teacher must in a district school admit all who *choose* to enter, and the district authorities *expect* him to govern all who *do* enter. They make no allowance for his failure. If he apply to his committee, they plainly tell him "he *must govern them*," and his ability to do it decides his fate. It were well if he had the *moral power* to mould the incongruous mass to his will. But if he have it not, the rod must do it for him, or he is ruined as a teacher, and the school is most seriously injured by his failure. As the law does not, and, as it is, *cannot* help him, we say,—*he must*, under present circumstances, *help himself.*

Much has been said by the gentleman from New York (Dr. Mason) upon parental responsibility, and upon a prompt expulsion from the school of all such as show a disposition to misspend their time, throwing them back upon their parents for discipline and culture. But what shall we do with those who have no parents? Are all such as happen, by the sins of

parents, to be neglected,—perhaps corrupted,—or all such as by the providence of God happen to be cast upon the tender mercies of a corrupting world, cut off from the endearing and sanctifying influences of home, of a father's counsel or a mother's love,—are all such to be abandoned as unfit for improvement, as unworthy of an effort of the teacher to pluck them from ruin and *save them*, and elevate them if possible to be useful and happy? Others may hold this doctrine, may proclaim it,—may practise it,—may turn upon the world those who may become twofold more the children of the devil; but for his part,—he said most emphatically,—*he did not hold to any such doctrine.* His own experience had convinced him that some of these very neglected ones could be saved, and, in the language of a famous Washingtonian lecturer, "THEY WERE WORTH SAVING!" Some of them had qualities as bright as diamonds of the first water, when polished; but that polishing could not always be achieved till the rough exterior had been removed by rougher means. That was indeed a sickly sentimentality that could not bear to remove the rubbish which covered so rich a gem. Turn out upon the world those who have been neglected, and know not the value of their privileges and their own capabilities! They are the very ones who most need culture, the very ones whom the faithful teacher should save, if possible. The rod has often wrought such salvation, by subduing and bringing under more kindly influences those, who but for the rod would have ruined themselves and proved a curse to their generation. Teachers, save these neglected ones,—do it by moral suasion, by the kindest influences, if you can,—but at any rate save them,—*even if it must be done with the rod.*

4. *The standard of qualification among the teachers, as they are, makes the use of the rod necessary.* He could wish the whole corps of teachers were a far more elevated class than they are. He would be glad if every teacher in the land had an amount of acquirement,—of self-culture,—of self-control,—of moral power and moral worth,—of dignity,—of patience under trial, and perseverance under discouragement, which would ensure, wherever he should go, the most complete success both in government and instruction. If such a day as could glory in *such* a corps should ever come, it would indeed be a happy day! But that day has not yet dawned upon us. The number of teachers is very large, and very large it *must* be; yet the number is small,—very small,—of those who can claim all the desirable qualities we sigh for. A majority of those who are employed, and who, for a long time to come, *must* be employed, are persons of limited endowments either natural or acquired. They are not such as can discern at a glance the peculiar traits of a room-full of troublesome and refractory scholars, and adapt their measures with the truest aim and the best assurance of success. They are such persons as must make many mis-steps in their attempts at gaining an influence over the obdurate and the vicious. Shall not their want of moral power, their want of true wisdom,—their want of the highest ability, then, be propped up by a little physical power? May

not the rod do for them what without it they could not do? Talk not of dismissing them generally; for this would be but shutting up the schools. Others of higher qualifications cannot yet be obtained. If the use of the rod be an evil, it certainly, in the present condition of things, is a necessary evil, and should not be altogether denounced until we have succeeded in improving the world in general, and our profession in particular, to such a degree, as to promise some measure of success without it.

He was not an advocate for general or frequent whipping. He simply claimed the *right* to such power when necessary; he would *hold it in reserve*, for such occasions as should imperiously demand it. Perhaps it would do as much as in any other way while in the *state of reserve*. Such was the fact in his own experience; and he had but little respect for the teacher who had had time to establish authority in his school, who could not get along and support good discipline *without* the frequent use of the rod. Practically he did but very little whipping, but he could not yet see his way clear to join in a crusade against an agent, which had, since the days of Solomon, been so useful, and which he feared had not yet done all that was assigned it in the work of improving our race.

Mr. Page apologized for detaining the audience half an hour with his remarks, and expressed some regret that he could not examine some of the remarks of those who had spoken before him; and particularly that he could not dwell a few moments upon the various *substitutes* so often proposed by those who object to corporal punishment. He must, however, again *protest* against this wholesale denunciation of corporal punishment, as he believed *most firmly* such denunciation did more than any other cause to perpetuate the necessity of it; and that should this Institute proclaim to the world that all such punishment ought from this time to be discontinued, and the world should adopt the sentiment, and in its present condition attempt to carry it out, *we should soon find that a very beautiful theory had been most ruinous in its application.*

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Always have a book within your reach, which you may catch up at your odd minutes.

Resolve to edge in a little reading every day, if it is but a single sentence. If you can gain fifteen minutes a day, it will be felt at the end of the year.

Regulate your thoughts when not at study. A man is thinking even while at work. Why may he not be thinking about something that is useful?

Revolve in your mind what you have last been reading.

Remember that most of the matchless effusions of Robert Burns were conceived while he was toiling after the plough.

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